

## REMARKS

This amendment is in response to the final Office Action dated May 22, 2009 (the Action). Claims 1-11, 13-23 and 25-27 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,285,502 to Walton et al. (Walton) in view of U.S. Patent No. 4,490,585 to Tanaka (Tanaka) and U.S. Patent No. 7,184,556 to Johnson et al. (Johnson). Claims 12 and 24 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Walton, Tanaka and Johnson in further view of U.S. Patent No. 4,109,107 to Boast (Boast).

In response, the independent claims have been amended to generally recite that the cutoff frequency is the same or lower than a resonant frequency of the electrodynamic transducer for the lower frequency range. In addition, the term “electromagnetic transducer” has been replaced with the term “electrodynamic transducer” for consistency. Support for the above amendments can be found, for example, in the Specification on page 8, lines 33-35. A Request for Continued Examination is filed concurrently herewith, and entry of the above amendments is respectfully requested.

Reconsideration of the above rejections is requested for the reasons presented below.

### **I. Claims 1, 14, 26 and 27**

Claim 1 is reproduced below:

1. A control circuit for a signal strength information dependent frequency response adaptation of an audio signal for an electrodynamic transducer, the circuit comprising:
  - a signal strength information determination means for determining a signal strength information according to a level of the audio signal, and
  - a frequency modifying means for selectively modifying the audio signal in response to the signal strength information to adapt the frequency response of the audio signal to the electromechanical properties of the electrodynamic transducer such that the electrodynamic transducer converts the audio signal into a low distortion sound signal for high levels of the audio signal and has a flat frequency response for low levels of the audio signal,

wherein a lower frequency range of the audio signal is modified with a gain that is different than a gain of a higher frequency range of the

audio signal, and a cutoff frequency separating the lower frequency range from the higher frequency range is shifted towards higher values for an increasing level of the audio signal and towards lower values for a decreasing level of the audio signal, the cutoff frequency being the same or lower than a resonant frequency of the electrodynamic transducer for the lower frequency range.

Independent Claims 14, 26 and 27 include recitations analogous to the recitations emphasized above in Claim 1.

The Action concedes that Walton and Tanaka do not disclose that the frequency response of the audio signal is adapted to the electromechanical properties of the electrodynamic transducer. *See* the Action, page 3. It is noted that both Walton and Tanaka are directed to hearing aid devices that modify an audio signal in order to filter out noise. Applicants submit that there is no apparent reason in the cited prior art to use the noise reduction technology of Walton and Tanaka to avoid sound distortion at high signal levels when reproducing an audio signal with an electrodynamic transducer.

The Action alleges that Johnson discloses an audio compensation system for adapting the frequency response of a signal to fit the electromechanical properties of an electrodynamic transducer. *See* the Action, page 3 (citing Johnson, col. 4, lines 55-67; col. 5, lines 1-21). Johnson relates to an audio compensation system for sound reproduction. The sound reproduction device in Johnson is characterized by a plurality of individual responses defining an overall response. These individual responses are simulated by a plurality of modification filters that receive an electrical audio signal to be reproduced. Furthermore, the device in Johnson includes a plurality of adjustable parameters associated with at least one of the modification filters, so that the responses of the modification filters can be adjusted accordingly. *See* Johnson, col. 4, lines 55-67; col. 5, lines 1-21. In sharp contrast, the frequency response of the audio signal according to Claim 1 is adapted to the electromechanical properties of the electrodynamic transducer such that the electrodynamic transducer converts the audio signal into a low distortion sound signal for high levels of the audio signal, but has a flat frequency response to low levels of the audio signal. Applicants submit that the modification filters and adjustable parameters of Johnson do not meet the

recitations of the independent claims, *i.e.*, Johnson does not disclose or render obvious adapting the frequency response of the audio signal to the electromechanical properties of the electrodynamic transducer or that the electrodynamic transducer converts the audio signal into a low distortion sound signal for high levels of the audio signal and has a flat frequency response for low levels of the audio signal.

In addition, the independent claims recite that a cutoff frequency separating the lower frequency range from the higher frequency range is shifted towards higher values for an increasing level of the audio signal and towards lower values for a decreasing level of the audio signal. The independent claims have been further amended to clarify that the cutoff frequency is the same or lower than a resonant frequency of the electrodynamic transducer for the lower frequency range. As discussed in Applicants' specification, if the signal intensity for electrodynamic transducer is beyond the limit given by the maximum signal intensity allowed for lower frequencies around the resonant frequency, a distorted or clipped sound signal will be reproduced. It is therefore desirable to attenuate the frequency components of an AF signal relative to its higher frequency components for high levels of the AF signal. However, for lower levels of an audio signal, there is generally a reduced risk of distortion in the transducer. Consequently, the full frequency range of the transducer can be used for a flat frequency response for lower levels of the audio signal. Therefore, a high pass filter can be provided such that the cutoff frequency is shifted to higher frequencies for increasing levels of the audio signal, and the cutoff frequency is substantially the same as or lower than the resonant frequency of the electrodynamic transducer being used for low-level audio signals. The risk of overloading the membrane decreases rapidly with increasing frequency due to the inversely proportional relation between oscillating amplitude of the membrane and the square of the AF signal frequency. For an AF signal approaching a certain limit, the cutoff frequency is shifted to higher values up to the frequency limit to reduce the chances that the electrodynamic transducer may be overloaded. *See Applicants' specification, page 8, line 24 – page 9, line 7.* These potential advantages of using a cutoff frequency that is shifted towards higher values for an increasing level of the audio signal and towards lower values for a decreasing level of the audio signal such that the cutoff frequency is the same or lower than

a resonant frequency of the electrodynamic transducer for the lower frequency range are not recognized in the cited prior art.

Although Boast (which is cited with respect to Claims 12 and 24) discusses a scaling factor of the mechanical response parameters of a transducer, Boast also does not disclose or render obvious that the electrodynamic transducer converts the audio signal into a low distortion sound signal for high levels of the audio signal and has a flat frequency response for low levels of the audio signal. Boast also does not provide any disclosure or suggestion of a cutoff frequency as recited in the independent claims.

Accordingly, Walton, Tanaka, Johnson and Boast do not disclose to render obvious a cutoff frequency that is based on the electromechanical properties of the electrodynamic transducer, and therefore, the cited prior art cannot disclose or render obvious that the cutoff frequency is the same or lower than a resonant frequency of the electrodynamic transducer for the lower frequency range as recited in the independent claims.

Applicants submit that the prior does not disclose or render obvious the recitations of independent Claims 1, 14, 26 and 27 for at least the reasons discussed above. Claims 2-13 and 15-25 are patentable at least per the patentability of the independent claims from which they depend. Accordingly, Applicants respectfully request that the rejections under 35 U.S.C. § 103(a) be withdrawn.

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### CONCLUSION

Accordingly, Applicants submit that the present application is in condition for allowance and the same is earnestly solicited. The Examiner is encouraged to telephone the undersigned at 919-854-1400 for resolution of any outstanding issues.

Respectfully submitted,

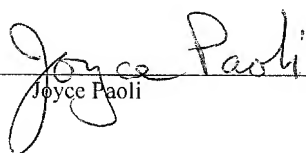


Laura M. Kelley  
Registration No. 48,441

**USPTO Customer No. 20792**  
Myers Bigel Sibley & Sajovec  
Post Office Box 37428  
Raleigh, North Carolina 27627  
Telephone: 919/854-1400  
Facsimile: 919/854-1401

### CERTIFICATION OF TRANSMISSION

I hereby certify that this correspondence is being transmitted via the Office electronic filing system in accordance with § 1.6(a)(4) to the U.S. Patent and Trademark Office on August 19, 2009.

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Joyce Paoli